Space Weather Technical Forecast

Issued on Friday 28 March 2025 at 01:14 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated G1/Minor storms. Chance of M-class flares (R1-R2; Minor-Moderate radio blackouts).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity reached Moderate levels, due to an isolated M2.0-flare from AR4043 in the northeast at 27/0037 UTC. There are currently five numbered sunspot regions on the Earth-facing solar disc, most small, weak and magnetically simple. AR4043 remains the most significant region and is classified as a Dai/beta-gamma. A new and unnumbered region is emerging on the northeast limb, and currently appears to be a mature, stable unipolar spot.

A small filament eruption occurred near centre disc, around 27/1115 UTC. Currently an associated CME has not been observed, although available chronograph imagery is limited. If a CME had been generated then it would potentially have an Earth directed component.

A larger filament eruption occurred around 27/2200 UTC from near S35E38. The associated CME will be analysed for any Earth directed component once adequate imagery is available.

Solar Wind / Geomagnetic Activity: Solar wind parameters as measured by DSCOVR at L1, continued to show the influence of a high speed stream (HSS) due to a connection with CH25/+. Initially strong speeds increased to reach very strong levels during the morning of the 27th, peaking at 870 km/s at 27/0730 UTC. Since then a slight decline has occurred, with solar winds currently back to strong levels around 780 km/s. Density has been below average. The Interplanetary Magnetic Field, Bt, started at strong levels at 19nT at 27/0011 UTC and since then has steadily declined to current weak levels around 5 nT. The north-south component, Bz, initially fluctuated between strong positive (northward) and moderate negative (southward) orientation, ranging from +17nT and -9nT. Through the period Bz declined to weak levels, also favouring a positive (northward) orientation. The phi angle was predominantly positive (away from the Sun). Geomagnetic activity was predominantly Active to G1/ minor geomagnetic storm levels (Kp 4-5).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at background levels. High energy electron flux (greater than 2 MeV) at GEO was at background increasing to moderate levels, with a peak level of 416 pfu at 27/1715 UTC . The 24-hour fluence was below the Active threshold. The observed integrated pfu was 7.77e6 at 28/0000 UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Low to moderate solar activity is expected, with a chance of further isolated M-class flares, probably from AR4043.

Solar Wind / Geomagnetic Activity: No clear Earth-directed CMEs currently feature in the forecast, although an eruption on 25th may give a slight chance of a glance on either days 2 or 3 (29 or 30th Mar), although this is low confidence. Currently only one of the two filament eruptions on the 27th appears to have generated a CME, this from the later eruption around 27/2200 UTC. The associated CME is awaiting analysis once adequate imagery is available, although at present this CME is thought unlikely to have an Earth directed component.

Solar winds are currently strong, around 770km/s, due to the HSS related to the unusually prominent positive coronal hole feature CH25 which dominates a large portion of the southern hemisphere. Solar winds are expected to remain strong through much of today (28th) and then gradually decline to slightly elevated levels for day 4 (31st Mar).

Mainly unsettled to active levels (Kp 3-4) are expected today (28th), with a chance of isolated G1/Minor Geomagnetic storm (Kp 5) intervals. Geomagnetic activity is then expected to steadily decline, becoming Quiet to Unsettled (Kp 1-3) through tomorrow (29th) but with a chance of isolated Active levels at first. Mainly Quiet activity (Kp 1-2) is expected by day 4 (31st).

Energetic Particles / Solar Radiation: High energy proton flux is expected to be at background levels, with a negligible chance of enhancement from any larger flares. High energy electron flux is expected to continue to increase, from initial Moderate levels to become diurnally High today or tomorrow (28 or 29th) and then probably predominantly High by the end of the period. The associated fluence is therefore expected to rise above the Active threshold (1e8 integrated pfu) by the end of the forecast period, possibly as soon as day 2 (29th).

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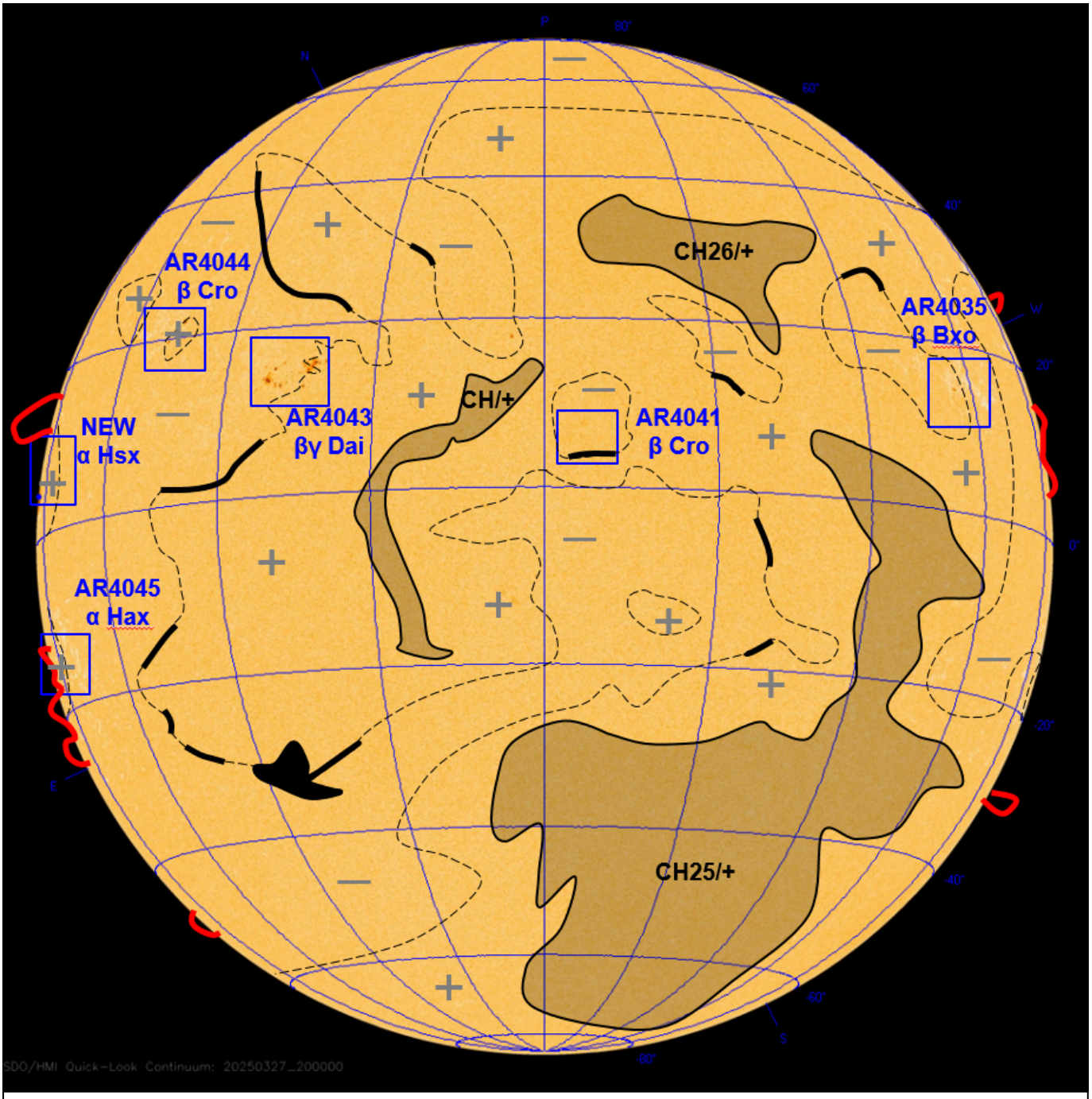
Figure 1: Synoptic Map valid 27/2000 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are no clear Earth-directed CMEs in the forecast at present, though an eruption on 25th may give a slight chance of a glance on either days 2 or 3 (29 or 30th Mar) as indicated my MOSWOC Enlil ensemble forecast, although this is low confidence. Currently only one of the two filament eruptions that occurred on the 27th appears to have generated a CME, this from the later eruption around 27/2200 UTC from near S25E38 The associated CME is awaiting analysis once adequate imagery is available. At present this CME is thought unlikely to have an Earth directed component, due to it's origin in the southeast quadrant and initial indications of having a strong southward component.

During the previous 24 hours solar winds exceeded 800 km/s at times, and currently winds are around 780 km/s, therefore faster than indicated by MOSWOC Enlil. However, MOSWOC Enlil output is considered to be providing good guidance by indicating a very gradual declining trend in the wind speed, following a similar trend to the previous rotation of this persistent CH feature. Solar winds are expected to remain strong through much of today (28th) and then gradually decline to slightly elevated levels for day 4 (31st Mar).

Mainly unsettled to active levels (Kp 3-4) are expected today (28th), with a chance of isolated G1/Minor Geomagnetic storm (Kp 5) intervals. Geomagnetic activity is then expected to steadily decline, becoming Quiet to Unsettled (Kp 1-3) through tomorrow (29th) but with a chance of isolated Active levels at first. Mainly Quiet activity (Kp 1-2) is expected by day 4 (31st).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	Yes	50	30	20	10
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
25/1741 UTC	Partial	Filament eruption	SE	1300 km/s	29/0600 UTC	Low confidnce as modelled on limited availability of imagery.

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Figure 2: Latest SDO/AIA image showing the large CH25 in the southwest quadrant.

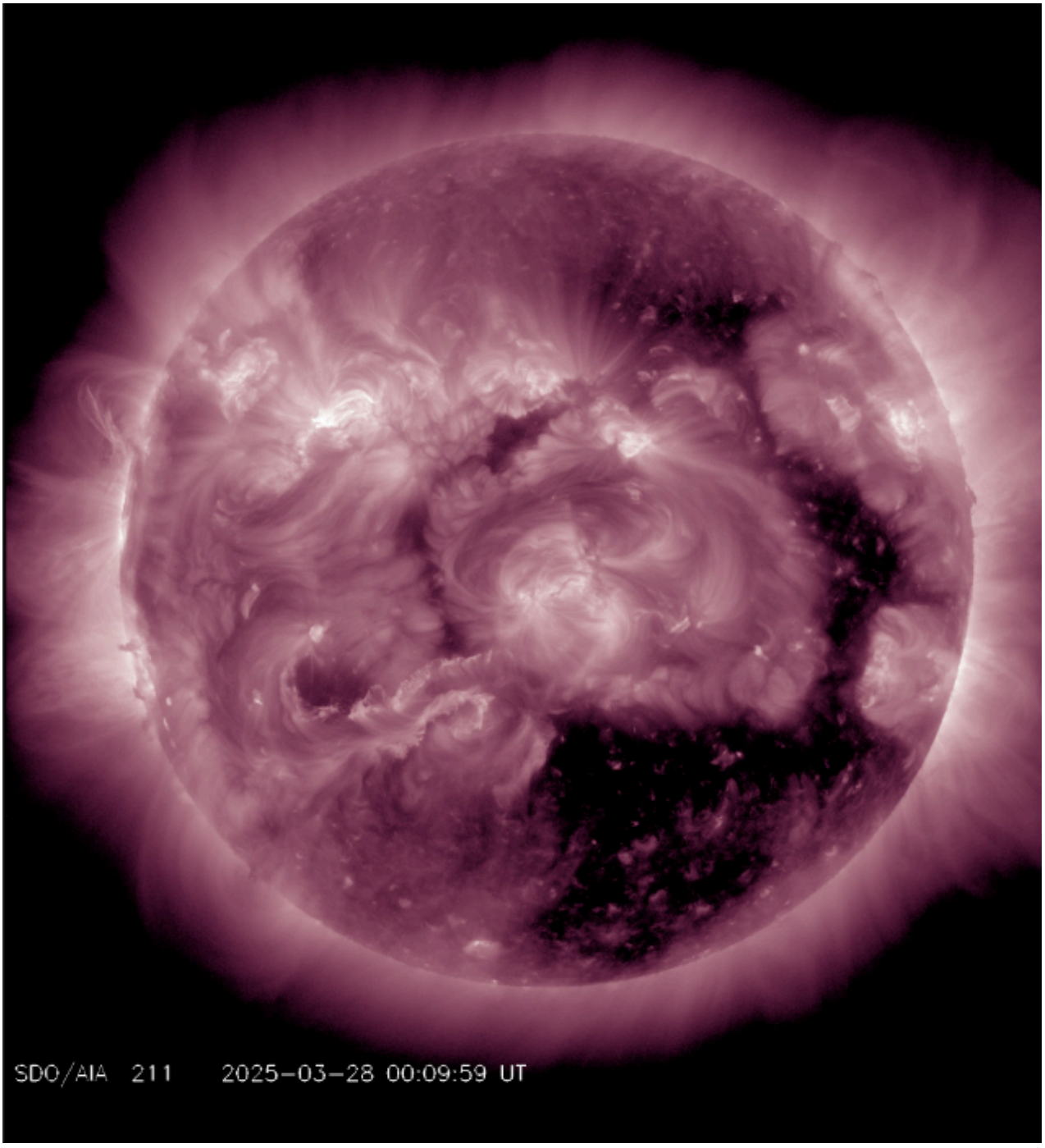

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Figure 3: MOSWOC Enlil.

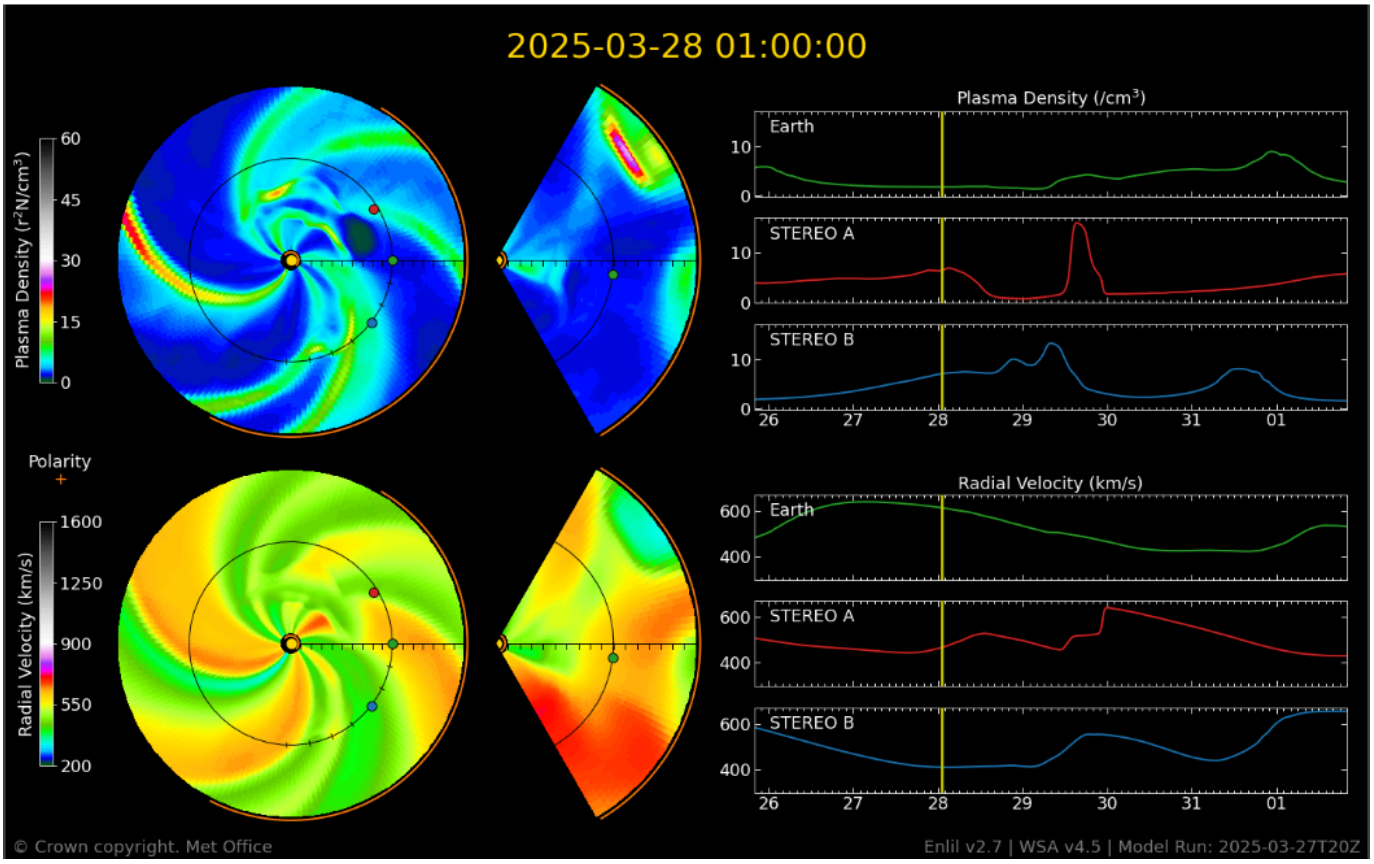
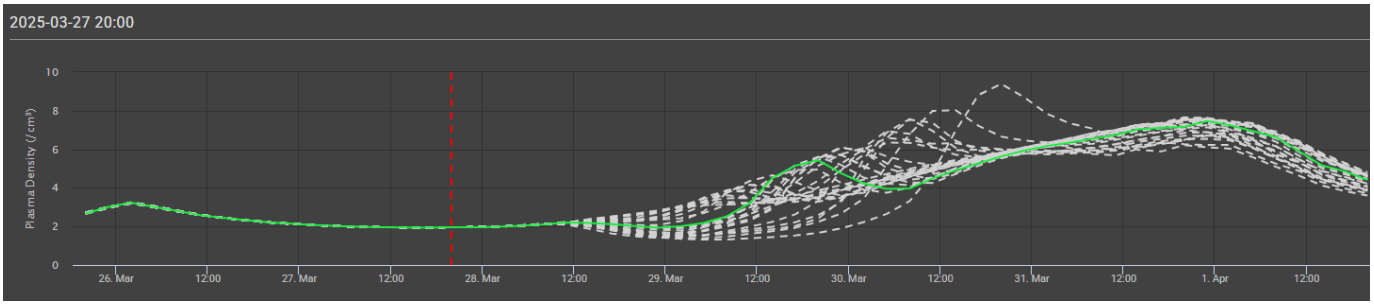


Figure 4: MOSWOC Enlil ensemble.



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Radio Blackouts - X-Ray Flares

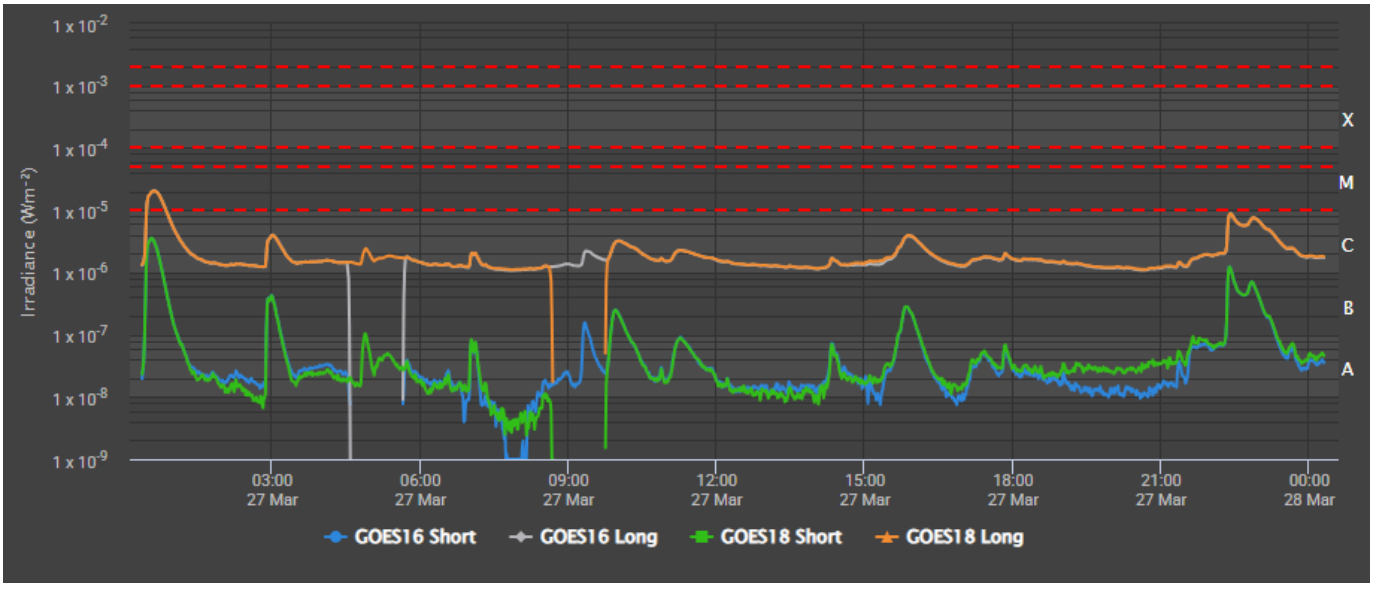
Solar activity reached Moderate levels, due to an isolated M2.0-flare from AR4043 in the northeast at 27/0037 UTC.

There are currently five numbered sunspot regions on the Earth-facing solar disc, all of which are small and magnetically simple. AR4043 has been the most active region on the disc despite being a relatively small, but slowly growing bipolar region, in the northeast. The region previously came close to developing a small weak delta spot within its leading spots, but recently showed signs of weakening and so it's classification remains as Dai/beta-gamma. A new and potentially large region is just appearing on the northeast limb and currently appears to be a mature, stable Hax/alpha or a Hhx.

Low to moderate solar activity is expected, with a chance of further isolated M-class flares, probably from AR4043. However, new or returning regions are expected through the forecast period and may increase the solar activity.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	Yes	30	30	30	30
Very Active	R3-R5 (X Class)	No	1	1	1	1

Figure 5:



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Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux was at background levels. Proton flux is expected to remain at background levels, with a negligible chance of enhancement due to the current lack of large, complex spot groups on the Earth facing disc.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2 MeV) measured by GOES16 at GEO was at background levels increasing to moderate levels through the past 24 hours. As the chance of enhanced geomagnetic activity (due to the HSS from CH25+) declines through the forecast period so the Van Allen belts should expand towards GEO, leading to a significant rise in the flux of high energy electrons from initial Moderate levels to become diurnally High today or tomorrow (28th or 29th) and then probably predominantly High by the end of the period.

The associated fluence is therefore expected to rise above the Active threshold (1e8 integrated pfu) by the end of the forecast period, possibly as soon as day 2 (29th). The MOSCOW REFM model is considered to be giving overall good guidance, showing fluence levels increasing above Active. However, confidence is lower in the speed of the Active threshold being breached, and confidence is significantly lower regarding the Very Active levels indicated by the model for days 2 and 3 (29th and 30th). Currently Very Active levels are not expected.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	50	70	90	95
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	5	10

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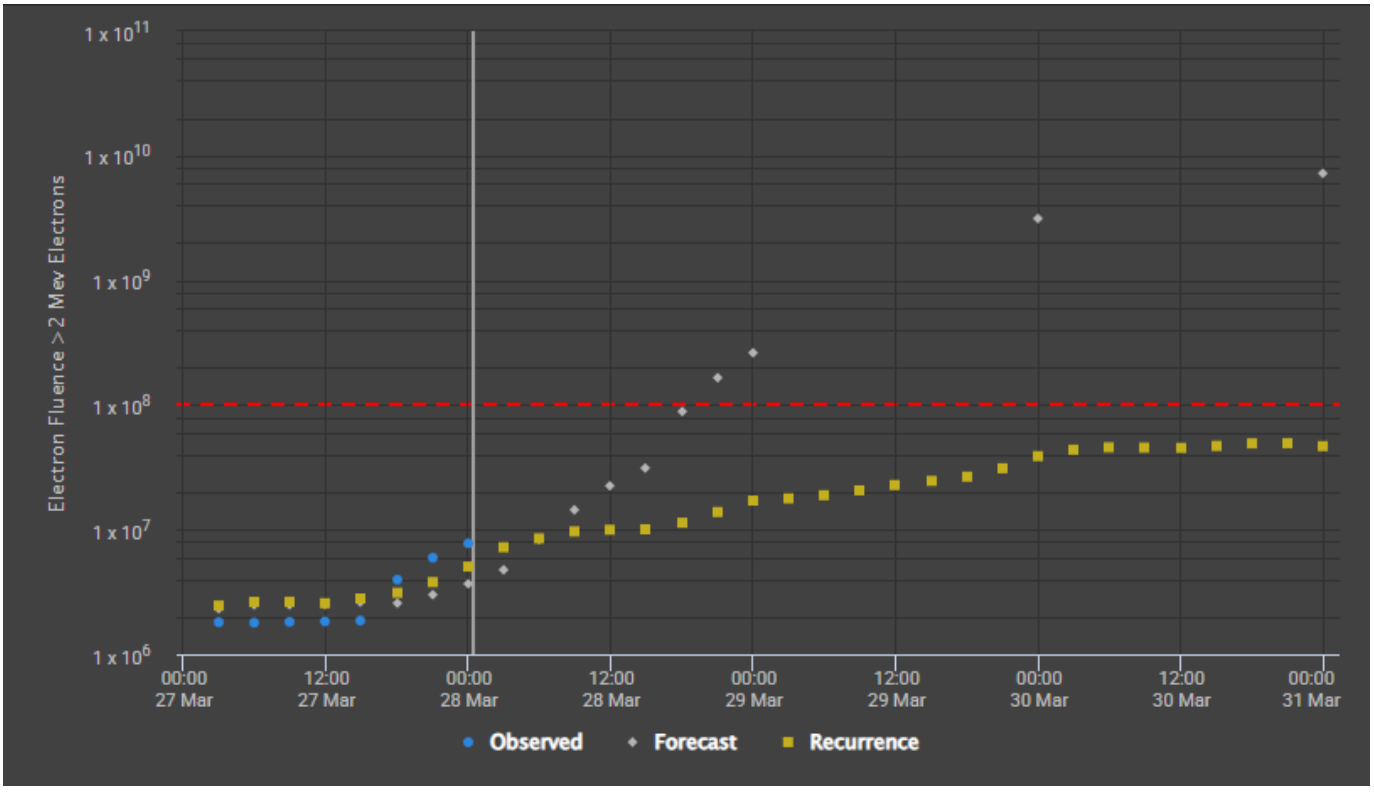
Figure 6:



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